Claims

1. A catalyst pellet for selective gas phase exothermic reactions in a tubular fixed bed reactor, said catalyst pellet comprising:
   a. a uniform cross-section or, if not uniform, a cross section having a deviation from the average cross-section area of less than 30%, wherein the cross-section is substantially parallelogram-shaped; and
   b. one or more through-bores, having:
      1. axes which are parallel to each other and to the axis of the pellet or, if not parallel, axes having a deviation from a parallel line of less than 20%; and
      2. uniform cross-sections, or, if not uniform, cross-sections having a deviation from the average cross-section of less than 30%; and

      wherein said one or more through-bores further comprise:
         i. one bore having the same shape as the cross-section of the pellet or two or more bores obtained by introducing internal reinforcing vanes in said one bore; or
         ii. two or more bores having a circular or elliptical shape and, if four or more bores are present, having different distances between the centres of the non-adjacent couples of bores.

2. A catalyst pellet according to claim 1 wherein the pellet has the following size: 4 mm < P_1 < 15 mm, 4 mm < P_2 < 15 mm, 0.5 mm < P_3 < 4 mm, 3 mm < P_4 < 15 mm; wherein P_1 is the main diagonal of the parallelogram, P_2 is the secondary diagonal of the parallelogram, P_3 is the maximum wall thickness, and P_4 is the length of the parallelogram.

3. A catalyst pellet according to claim 2 wherein the pellet has the following size: 4 mm < P_1 < 9 mm, 4 mm < P_2 < 9 mm, 0.7 mm < P_3 < 2 mm, 4 mm < P_4 < 8 mm.

4. A catalyst pellet according to claim 1 wherein the pellet has a rhomboidal cross-section with at least one reinforcing vane connecting two opposite edges and at least two bores.

5. A catalyst pellet according to claim 4 wherein the pellet has the following size: 4 mm < R_1 < 15 mm, 4 mm < R_2 < 15 mm, 0.5 mm < R_3 < 3 mm, 3 mm < R_4 < 15 mm; wherein R_1 is the longest size of the cross-section, R_2 is the shortest size of the cross-section, R_3 is the largest wall thickness of the bores, and R_4 is the length.

6. A catalyst pellet according to claim 5 wherein the pellet has the following size: 4 mm < R_1 < 9 mm, 4 mm < R_2 < 9 mm, 0.7 mm < R_3 < 2 mm, 4 mm < R_4 < 8 mm.

7. A catalyst pellet according to claim 1 wherein the pellet has a rhomboidal cross-section with at least one reinforcing vane connecting two opposite sides and at least two bores.

8. A catalyst pellet according to claim 7 wherein the pellet has the following size: 4 mm < R_1 < 15 mm, 4 mm < R_2 < 15 mm, 0.5 mm < R_3 < 3 mm, 3 mm < R_4 < 15 mm; wherein R_1 is the longest size of the cross-section, R_2 is the shortest size of the cross-section, R_3 is the largest wall thickness of the bores, and R_4 is the length.

9. A catalyst pellet according to claim 8 wherein the pellet has the following size: 4 mm < R_1 < 9 mm, 4 mm < R_2 < 9 mm, 0.7 mm < R_3 < 2 mm, 4 mm < R_4 < 8 mm.

10. A catalyst pellet according to claim 7 wherein the pellet has a square cross-section with at least two reinforcing vanes and four bores.

11. A catalyst pellet according to claim 10 wherein the pellet has the following size: 3 mm < Q_1 < 10.5 mm, 0.5 mm < Q_3 < 3 mm, 3 mm < Q_4 < 15 mm; wherein Q_1 is the side of the square, Q_3 is the wall thickness, and Q_4 is the length.

12. A catalyst pellet according to claim 11 wherein the pellet has the following size: 4 mm < Q_1 < 9 mm, 0.7 mm < Q_3 < 2 mm, 3 mm < Q_4 < 8 mm.

13. A catalyst pellet according to claim 1 wherein the pellet has a rhomboidal cross-section with at least four circular bores.

14. A catalyst pellet according to claim 13 wherein the pellet has the following size: 4 mm < T_1 < 15 mm, 4 mm < T_2 < 15 mm, 0.5 mm < T_3 < 3 mm, 3 mm < T_4 < 15 mm; wherein T_1 is the longest size of the cross-section, T_2 is the shortest size of the cross-section, T_3 is the largest wall thickness of the bores, and T_4 is the length; and wherein the diameter of the bores is between 0.7 and 3 mm.

15. A catalyst pellet according to claim 14 wherein the pellet has the following size: 4 mm < T_1 < 9 mm, 4 mm < T_2 < 9 mm, 0.7 mm < T_3 < 2 mm, 3 mm < T_4 < 8 mm.

16. A catalyst pellet according to claim 1 wherein the sides and/or the corners of the external contour of the pellet cross-section are rounded in such a way that the ratio between the area of the cross-section of the pellets, including the cross-section of the bores, and the area of the parallelogram circumscribing the external contour of the pellet cross-section is greater than 0.75.

17. A catalyst pellet according to claim 16 wherein said ratio is greater than 0.85.

18. A catalyst pellet according to claim 1 wherein the sides of the external contour of the pellet cross-section are curved, the curve being convex or concave or both.

19. A catalyst pellet according to claim 18 wherein the curve is convex.

20. A catalyst pellet according to claim 1 wherein the sides and/or the edges of the external contour of the pellet cross-section are curved, and the curves corresponding to the sides of the external contour of the cross-section are concave and the curves corresponding to the edges of the external contour of the cross-section are convex.

21. A catalyst pellet according to claim 1 with one bore having the same shape as the cross-section of the pellet or, optionally, with two or more bores obtained by introducing internal reinforcing vanes in said one bore, wherein the sides and/or the corners of the contour of the bores cross-section are rounded in such a way that the ratio between the area of the cross-section of the bores and the area of the cross-section of the parallelogram circumscribing the external contour of the bores is higher than 0.75.

22. A catalyst pellet according to claim 21 wherein said ratio is higher than 0.85.

23. A catalyst pellet according to claim 1 with two or more bores obtained by introducing internal reinforcing vanes in one bore having the same shape of the cross-section of the pellet, wherein said reinforcing vanes are disposed to connect the opposite edges or the opposite sides of the external contour of the bore cross-section.

24. Process for making the pellets of claim 1, wherein the pellets are formed by extrusion or tableting.

25. A method for selectively catalyzing gas phase exothermic reactions comprising employing in said reaction a catalyst pellet according to claim 1.

26. The method of claim 25, wherein the gas phase exothermic reactions are selected from the selective chlorination and/or oxychlorination of alkenes or alkanes and the selective oxidation of alkenes.

27. The method of claim 26, wherein the reactions are further selected from: the conversion of ethylene with chlorine to 1,2-dichloroethane; the conversion of ethylene with hydrogen chloride with air or oxygen to give 1,2-dichloroethane; the conversion of ethane with hydrogen chloride with air or oxygen to give saturated and unsaturated chlorinated hydrocarbons; and the reaction of methane with chlorine.

28. The method of claim 27, wherein the catalyst for the oxychlorination reaction of ethylene contains copper in an amount of 1-12 wt%.

29. The method of claim 28, wherein the catalyst for the oxychlorination reaction of ethylene further comprises at least one of the alkali metals, alkaline earth metals, group IIB metals or lanthanides in a total amount up to 15 wt%.

30. The method of claim 29, wherein the alkali metal is lithium, potassium or cesium or a combination thereof.

31. The method of claim 29, wherein the alkali earth metal is magnesium.

32. The method of claim 29, wherein the lanthanide is cerium or lanthanum or a combination thereof.

33. The method of claim 27, wherein the catalyst for the oxychlorination reaction of ethane contains copper and/or nickel and an alkali metal.

34. The method of claim 33, wherein the catalyst for the oxychlorination reaction of ethane further comprises at least one of the alkaline earth metals, group IIB metals or lanthanides.

35. The method of claim 27, wherein the catalyst for the selective oxidation reaction of ethylene further comprises silver and at least one of the alkali or alkaline earth metals.

36. A method for selectively catalyzing gas phase endothermic reactions comprising employing in said reaction a catalyst pellet according to claim 1.